OVERVIEW OF THE MARS 2020 MISSION PERSEVERANCE ROVER THIRD SCIENCE CAMPAIGN: EXPLORING JEZERO CRATER'S UPPER FAN. M. Nachon[1], K. L. Siebach[2], S. Sholes[3], V. Z. Sun[3], T. Del Sesto[3], B. P. Weiss[4], K. M. Stack[3], K. A. Farley[5], F. Calef[3], N. Mangold[6], J. Hurowitz[7], G. Caravaca[8], P. Russell[9], C. Quantin-Nataf[10], J. I. Núñez[11], S. Alwmark[12], A. Annex[5], R. Williams[13], A. Broz[14], A. Czaja[15], M. Tice[1], Y. Liu[5], S. Gupta[16], E. Dehouck[10] and the CPSG and the Mars2020 Science, Engineering and Operations Teams.
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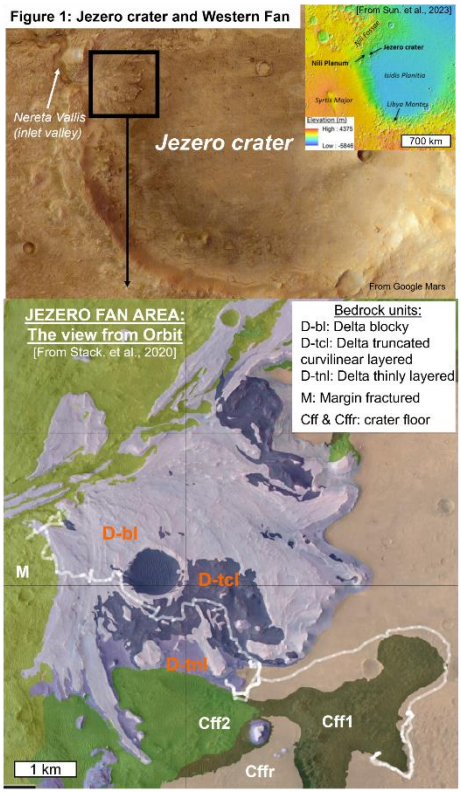
Introduction: The objective of the Mars 2020 mission is to characterize the geologic history and astrobiological potential of Jezero crater, as well as to collect and document a suite of samples for potential future return to Earth **[1]**. Jezero crater was selected as the landing site for the *Perseverance* rover in part due to the presence of the exceptionally well-preserved "western fan" (Fig. 1). This fan was interpreted from orbiter images to be a river delta, formed in the late Noachian to early Hesperian in a lake that was once present inside the crater **[2-5]**. The Upper Fan Campaign is the third campaign of the Mars 2020 mission. It began in February 2023 (sol 708) with the rover's arrival at the top of the fan front and ended in September 2023 (~sol 910) when the rover crossed into the Margin unit lining the inner crater rim (Fig. 1).

Jezero Upper Fan Campaign planning: Similar to the two previous campaigns of the mission **[8]**, a Mars 2020 Campaign Planning Science Group (CPSG) composed of volunteer science team members and led by two Campaign Science Leads (CSLs, M. Nachon and K. Siebach) was tasked with assembling a campaign plan that identified: (1) notional sampling strategies to acquire a set of samples that represented the diversity of lithologies of the Upper Fan, included the youngest detrital sediments, while also seeking astrobiologically-relevant lithologies; (2) locations where these samples could be acquired in the units of the fan and where science investigation could be conducted with the suite of instruments onboard the rover; (3) a strategic route, in terrains traversable by the rover, that optimized a path through the key locations of interest and sampling sites. The CPSG and CSLs, together with the Campaign Science Engineering Liaison S. Sholes and the Sample Shepherd B. Weiss, worked from Nov. 2022 through Jan. 2023 to construct a Campaign Plan before the Campaign started in Feb. 2023.

The orbital view and Campaign objectives: Prior to landing, the major geologic units identified on the Upper Fan based on orbital data **[7]** included: the Curvilinear unit (characterized by alternating stacks of light and dark-toned curved parallel strata, that were previously interpreted as sinuous river deposits) and the Blocky unit (characterized by boulder accumulations) (Fig. 1). A major objective for the Campaign was to characterize each of these units, identify their major lithologies as well as their geometries to understand their depositional context, and acquire samples.



Main Campaign Areas explored and Samples collected: During this ~8 months campaign, *Perseverance* explored coarse-grained fluvial-deltaic deposits representing at least 2 distinct episodes of aqueous activity within the crater (Fig. 2) **[9-21]**. Moreover, 3 samples (*Melyn*, *Otis Peak*, and *Pilot Mountain*), sandstone- and conglomerate- bearing, were acquired and added to *Perseverance*'s onboard sample collection **[22]**; these samples could upon their return on Earth further enable studies of a Martian source-to-sink sedimentary system and inform how surface environments and aqueous processes evolved through time both within the catchment area of the original detrital material and within the delta sediments after deposition in Jezero.

Beagle Gap traverse: at the beginning of the ascent from the delta front onto the upper fan, a brief stop was performed at the *Jenkins Gap* area (Fig. 2; sols

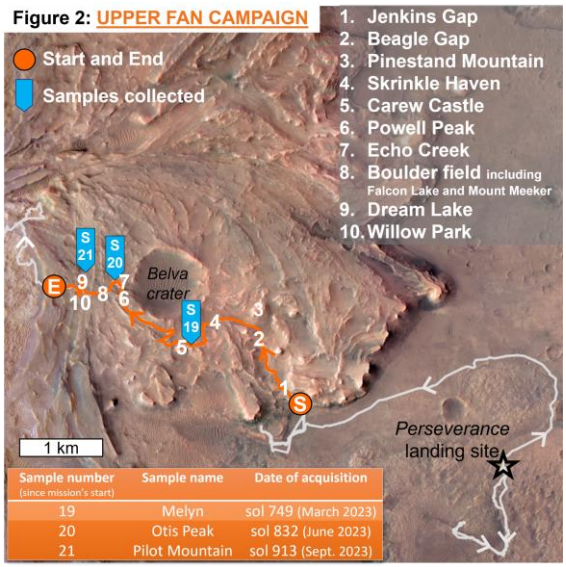
711-712): a light-toned outcrop that may be similar to the Curvilinear sandstones. Further North, *Pinestand Mountain* (Fig. 2; sol 718) is a butte with steeply dipping layers (>20°) that create the distinctive Curvilinear unit in orbital images **[23]**; images acquired with the rover show massive layered intervals of medium sandstone and pebbly conglomerate.

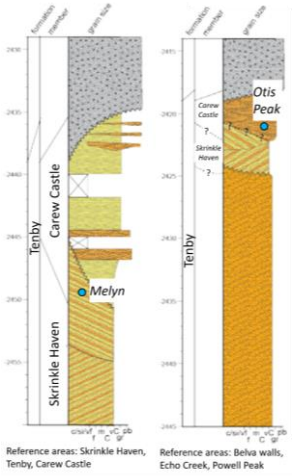
The *Tenby* outcrop (Fig. 2; sols 737-752) is the type location for the Curvilinear unit. It includes alternating erosion-resistant dm-scale bands of lighter-toned sandstone and recessive darker coarser-grained beds. The *Melyn sample* (sealed in March 2023; corresponding abraded patch: "*Solva*") was acquired in these light toned bands, and shows detrital mafic grains, altered silicates with some Mg, Fe carbonate grains, coatings, and possible cement. Prior to observations via *Perseverance*, the Curvilinear units depositional model was interpreted as sinuous river systems; in-situ observations suggest that alternative depositional models such as accretion on downstream migrating bars or delta mouthbars/foresets need to be considered **[9]**. The nearby *Carew Castle* butte consists of cross-stratified pebbly sandstone that erosionally overlies the Curvilinear unit and likely records a younger episode of fluvial system **[9]**.

At *Powell Peak*, the *Otis_Peak* sample (sealed on sol 832; corresponding abraded patch: *Ouzel Falls*) corresponds to a cross-stratified conglomerate interpreted as part of a higher-energy delta plain braided river deposit in the *Carew Castle* member of the *Tenby* formation. This sample represents a conglomerate layer that appears stratigraphically higher than the Curvilinear unit, but below the Blocky unit. Proximity science and remote sensing indicate *Otis Peak* contains coarse (up to 4 mm) detrital primary and altered silicates with Fe, Mg carbonates **[10,24]**. Close to *Powell Peak*, West of the Belva crater, *Echo Creek* (Fig. 2; sols 7720783) is a light-toned outcrop that is a likely bedding-plane exposure of the Curvilinear unit.

The boulders imaged and analyzed throughout this Campaign seems to correspond to 2 main classes **[25-28]**: one spectrally olivine-dominated, and another that is spectrally pyroxene-dominated. Abrasion patches were performed on 2 boulders representatives of these classes: the *Falcon Lake* boulder (abraded patch *Lake Haiyaha*) is olivine rich, with minor trace minerals, minor serpentinization and patchy carbonate and sulfates. The *Mount Meeker* boulder (abraded patch *Dragon's Egg Rock*) proved challenging to abrade given its hardness; it is mostly crystalline, with an Al-rich pyroxene-like composition.

Further West, *Dream Lake* is part of a set of polygonal outcrops at the base of the depression along the western side of delta "lobe K" **[29]**. The *Pilot Mountain* sample (acquired on sol 882 and sealed on sol 913; corresponding abraded patch: *Gabletop Mountain*) is a poorly sorted sandstone with granule-sized clasts, with abundant carbonate and silica content. These sandstones, including this sample, are interpreted as fluvial in origin, with *Pilot Mountain* appearing to have experienced aqueous alteration.





After the Upper Fan Campaign: Following this Campaign, the Mars 2020 mission transitioned to the Margin Unit Campaign **[30-36]**.

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